MODEL 250

ELECTROMETER MULTIMETER

SERIAL NOS. PREFIXED A

E-H RESEARCH LABORATORIES, INC.
16?? ADELINE STREET · OAKLAND, CALIFORNIA 94607

MP MASTER
MA27860

MODEL 250

ELECTROMETER MULTIMETER

SERIAL NOS. PREFIXED A

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E-H RESEARCH LABORATORIES, INC.
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E-H RESEARCH LABORATORIES, INC.
515 11th St. Box 1289 Oakland, Calif. 94604 • (415) 834-3030

PO 219268
Chg 235-050
Dat 4601
P/R 1026

July 16, 1970

Mr. Joe Dudley
Radiation Inc.
Melbourne, Florida 32901

Dear Mr. Dudley:

Your E-H Model 250 Multimeter, S/N A0137, which we have had for a considerable length of time, attempting to repair and calibrate, appears as though the cost to do so would be uneconomical.

There is a drift problem at high current sensitivity, which has been traced to the switch contacts on the range switch. We have been able to clear the problem by cleaning the switch throughly, but after a couple of days of operating the drift reappears.

The charges accumulated at this point are $203.50. We feel that to go beyond this would be more than the instrument is worth. Please advise us, as to the disposition of this order.

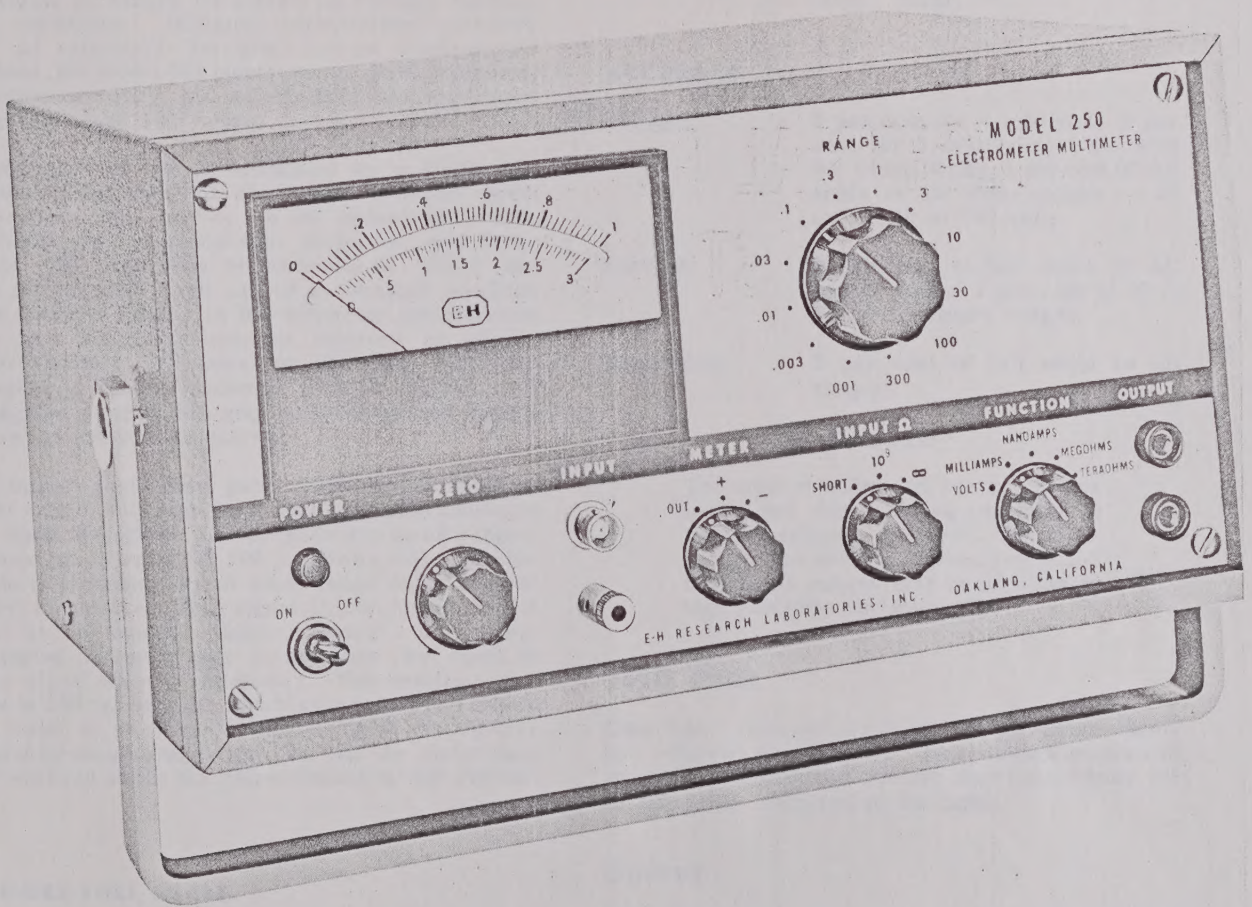
Very truly yours,

Earl Jones

Earl Jones
Customer Service

RECEIVED
JUL 22 1970
MATERIEL ADMIN.

EJ:jr


MODEL 250
ELECTROMETER MULTIMETER
RANGE
.3
1
3
.1
10
.03
30
.01
100
.003
300
.001
0
.2
.4
.6
.8
1
5
1
1.5
2
2.5
3
EH
POWER
ON
OFF
ZERO
INPUT
METER
OUT
+
−
INPUT Ω
SHORT
10⁹
∞
FUNCTION
NANOAMPS
MEGOHMS
MILLIAMPS
TERAOHMS
VOLTS
OUTPUT
E-H RESEARCH LABORATORIES, INC.
OAKLAND, CALIFORNIA

SPECIFICATIONS

The Model 250 is a compact, versatile instrument providing 60 ranges for measuring voltage, current, and resistance. Utilizing transistorized circuitry and an extremely low grid current electrometer pentode, the Model 250 combines low drift, low noise, excellent accuracy, and an effective input impedance of greater than 10^{15} ohms.

Convenience of use is facilitated by a single 12-position range selector and a mode selector which determines the function to be measured: volts, milliamperes, nanoamperes, megohms, and teraohms. The input may be switched to "short" for fast zeroing after warm-up, or an overload condition on a sensitive range. In the voltmeter configuration the input impedance may be selected as infinity (approximately 10^{16} ohms) or 10^{9} ohms, and when switched to "short" presents an input resistance of 1 megohm so that this may be accomplished without removing the voltage source.

The mirror scale front panel meter is calibrated to 1 per cent of full scale, and high precision resistors are used throughout for best accuracy on all ranges. A rear panel output of 100 millivolts full scale for range is provided. Front panel output jacks provide a low impedance output signal if the Model 250 is used as an amplifier (approximately 1 or 3 volts, depending on range when an ammeter, and equal to input signal when a voltmeter). The amplifier band pass is 500 cps and the meter selector switch allows the meter to be removed when using an external recorder or monitoring device, so that the meter back emf does not affect the measurement of fast signals.

RANGES FULL SCALE

Voltage:	1, 3, 10, 30, 100, 300 millivolts; 1, 3, 10, 30, 100, 300 volts (to 30 KV with Model 2502 Probe).
Current:	0.3 to 10^{-12} amperes: 1X and 3X steps.
Resistance:	1 K to 3 x 10^{12} ohms: 1X and 3X steps, linear.

ACCURACY

Voltage:	5 per cent for 1 millivolt; 3 per cent for 3 millivolts; 2 per cent for 10 millivolts; 1 per cent of full scale on all other ranges --- 30 millivolts to 300 volts.
Current:	2 per cent of full scale on all ranges except 3 per cent on 10 to 300 milliampere ranges.
Resistance:	3 per cent of full scale on all ranges.

NOTE

The input switches and connectors are baked and doped during assembly to resist moisture; however, the accuracy on the most sensitive current and resistance ranges may be impaired in high humidity environments.

ZERO DRIFT

Less than 1 millivolt per hour after 15 minute warm-up, referred to the input. Line voltage coefficient less than 0.5 millivolt for line fluctuations from 105 to 125 volts, referred to the input.

OUTPUT

Rear Panel:	BNC jack, 100 millivolts full scale for each range.
Front Panel:	Banana jacks. Equal to input when voltmeter. Approximately 1 or 3 volts when ammeter depending on 1X or 3X range position.

INPUT IMPEDANCE

Selectable, either 10^9 or greater than 10^{15} ohms shunted by approximately 10 mmf when voltmeter on all ranges from 1 millivolt to 10 volts. 10^9 only on 30, 100, and 300 volt ranges.

AMPLIFIER

Response:	DC to 500 cps.
Grid Current:	Less than 3×10^{-15} amperes.
Input Protection:	11 megohms. (Additional 1 megohm when voltmeter to prevent shorting source.)

NOISE

Total hum and noise less than 2 per cent of full scale.

DIMENSIONS

Cabinet Mounted:	6" high, 12" wide, 9" deep.
Rack Mounted:	7" high, 19" wide, 9" deep.
Weight:	10 lbs. net; 16 lbs. packed; 26 lbs. packed for export.

POWER REQUIREMENTS

115/230 volts, 50/60 cycles, 20 watts.

ACCESSORIES

Model 2501 Shielded Test Lead.

Model 2502 High Voltage Probe, provides 100:1 attenuation, allows measurements to 30 KV.

Model 2503 Shielded Test Probe, for convenient measurements.

WARRANTY

This instrument is guaranteed to be free of defects in materials and workmanship for a period of one year following delivery. Excluded items under this warranty are tubes, fuses, transistors, and diodes. In the event of failure, written notice of the nature of the trouble and the instrument serial number should be sent to the factory. E-H Research Laboratories, Inc., will then send instructions for component replacement or return shipment to the factory or local representative.

OPERATING INFORMATION

LOW LEVEL PHENOMENA

Because of various low level electrical phenomena, care must be exercised in making measurements on the most sensitive current and voltage ranges, and the highest resistance ranges. Such phenomena as thermoelectric effects, triboelectric effects (flexing of coaxial cables), dielectric absorption, and galvanic action can affect the accuracy of a measurement if they are not taken into consideration. The Model 250 has been carefully designed and shielded to eliminate these effects from within the unit. However, the instrument does not distinguish between stray and signal voltages or currents that are presented at the input; it measures the total voltage or current.

Special cables designed for extremely low triboelectric effect are available from E-H. See the paragraph entitled "Accessories" in the Specifications section.

TURN—ON PROCEDURE

Before turning on the instrument, always turn the INPUT IMPEDANCE selector to SHORT. If the selector is left in the 10^9 or INFINITE position, no damage will occur to the instrument; however, stray fields at the input can cause the panel meter and any external recorder to be driven off scale.

CAUTION

This instrument is not protected against extreme overload. Excessive input voltages will drive the electrometer grid into the conducting region, causing a temporarily high grid current. This will appear as a sudden change in amplifier zero and a high rate of zero drift. Should this happen, refer to the Maintenance Section for remedial procedures.

OPERATION

1. Set INPUT IMPEDANCE selector to SHORT.
2. Set METER switch to OUT.
3. Turn the POWER switch ON and allow 15 minutes warm-up for temperature stabilization.

VOLTAGE MEASUREMENTS

a. Set FUNCTION switch to VOLTS.

b. Set RANGE selector to the desired range.

c. Set METER switch to desired polarity and adjust ZERO control for zero meter indication.

d. Connect voltage to be measured to input connector.

e. Set the INPUT IMPEDANCE selector to the desired impedance, and read the voltage.

CURRENT MEASUREMENTS

a. Set FUNCTION switch to the desired current function -- either MILLIAMPS or NANOAMPS.

b. Set RANGE selector to the desired range.

c. Set METER switch to the desired polarity and adjust the ZERO control for zero meter indication.

d. Connect current to be measured to input connector.

e. Set the IMPEDANCE SELECTOR to either 10^9 or INFINITY and read the current.

RESISTANCE MEASUREMENTS

a. Set FUNCTION switch to the desired resistance function -- either MEGOHMS or TERAOHMS.

b. Set RANGE selector to the desired range. Note that the highest range is 3 teraohm full scale.

c. Set METER switch to + and adjust the ZERO control for zero meter indication.

d. Connect the resistance to be measured to the input connector.

e. Set the IMPEDANCE SELECTOR to INFINITY and read the resistance.

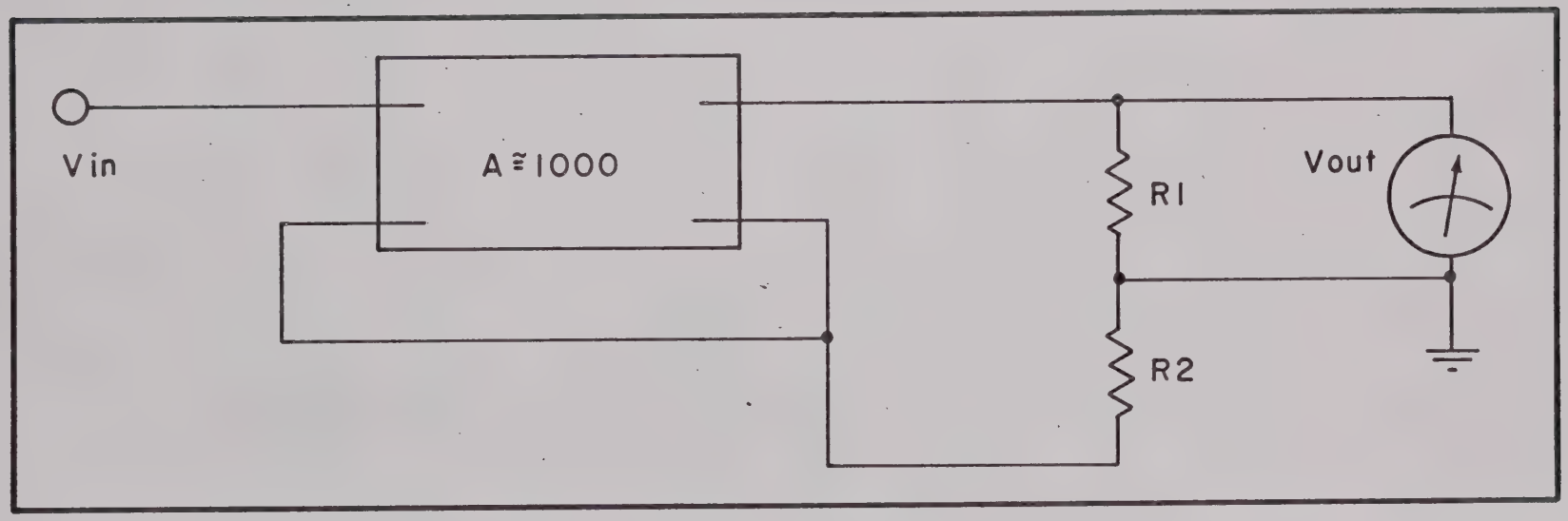


Figure 1a. — Model 250 Voltmeter Configuration.

Pg 24

THEORY OF OPERATION

GENERAL DESCRIPTION

The Model 250 is a very stable DC amplifier with an input tube that has a grid current of less than 3×10^{-15} amperes. This very small grid current permits the extremely high sensitivity that this instrument has. Stability is achieved by using well-regulated supplies and a negative feedback loop. Further stability is obtained by an additional feedback loop and by the use of low noise resistors in critical circuits.

The amplifier is completely transistorized with the exception of the input electrometer tube. Total gain of the amplifier is approximately 1000 with voltages up to 10 volts being developed at the output.

Precision resistors have been used to obtain greatest accuracy, and on those ranges where high quality precision resistors are unobtainable potentiometers have been placed in series with 10 per cent resistors.

VOLTMETER MEASUREMENTS

The voltmeter configuration is shown in Figure 1a. R1 is a parallel resistor network (including meter resistance) which has a net value of 175 ohms. R2 is the feedback resistor; its value is different for each range and is chosen so that 100 millivolts are developed across R1 for a full scale input voltage. The equation governing the relationship is:

$$V_{out} = V_{in} \frac{A}{1 + \frac{R2}{R1}(A + 1)}$$

Amplification gain, it can be seen, affects accuracy only on the most sensitive ranges. On these ranges the accuracy of the instrument is specified to allow for a very reasonable change in gain over a period of time. The only other factors affecting accuracy are the accuracy of resistor R1, resistor network R2, and the meter accuracy.

R1 is accurate within $\pm .5$ per cent.
R2 is accurate within $\pm .2$ per cent.

The meter scale is hand-calibrated and set so that the total output error is less than one per cent of full scale. (Note that the accuracy of R1 and R2 affect the instrument accuracy as a per cent of reading -- not per cent of full scale.)

On the 30, 100, and 300 volt ranges, the input voltage is divided down and R2 is a variable resistor which sets the accuracy of each of these ranges.

AMMETER MEASUREMENTS

The ammeter configuration is shown in Figure 1b. Resistor R1 provides a 100 per cent feedback loop. Values of R1 are chosen in decade steps and each resistor is used on two consecutive ranges. For instance, R1 is 10^6 ohms on the 10^{-6} and 3×10^{-6} ampere ranges. For an input current of 10^{-6} amperes, 1 volt will be developed at the amplifier output (junction R1 and R2). This is divided by the 9:1 ratio of R2 and R3 to produce 100 millivolts output (full scale on the 10^{-6} ampere range).

When the range is changed to 3×10^{-6} amperes, R1 remains the same and 3 volts are developed at the amplifier output for a full scale input. R2 is replaced by a higher value resistor on this range so that the division ratio of R2 to R3 is 29:1, and 100 millivolts is still developed across R3 for a full scale reading.

The amount of voltage drop at the input is:

$$V_{drop} = \frac{V_{out}}{A}$$

Where V_{out} is the voltage developed at the amplifier output (1 volt or 3 volts full scale) and A is the amplifier gain, A is nominally 1000 so the voltage drop at the input is at the most 3 millivolts.

The 2 per cent accuracy of the ammeter is conservatively specified and takes into account the accuracy of the feedback resistor R1, the division ratio of R2 and R3, the meter movement accuracy, and the possible gain variations of the amplifier over a period of time.

There are no satisfactory precision high megohm resistors presently available to use as R1 on the most sensitive current ranges. If any of the current "precision" high megohm resistors were used, the accuracy specification would have to be changed from 2 per cent to 3 or 4 per cent on the most sensitive ranges.

To provide the 2 per cent accuracy, very stable, high quality, 10 per cent resistors are used and R3 is made variable to control the division ratio of the amplifier output so that 100 millivolts output is obtained for a full scale input.

RESISTANCE MEASUREMENTS

The resistance configuration is diagrammed in Figure 1c. The unknown resistor is R_X. Measurement is accomplished by generating a known current

$$\frac{(10V)}{(R1)}$$

through the unknown resistor. This creates a voltage at the input of the amplifier, which also appears at the amplifier output. This voltage is divided by the ratio of R3 to R2 to produce a 100 millivolt output signal for an input resistance large enough to cause a full scale meter deflection.

Resistor, R1, is increased in decade steps every second switch position. In the 1 x 10^X position 1 volt is produced at the amplifier output. In the 3 x 10^X position 3 volts are produced. Resistor R3 increases on the 3 x 10^X position so that the division ratio of R3 to R2 will always produce a 100 millivolt full scale voltage.

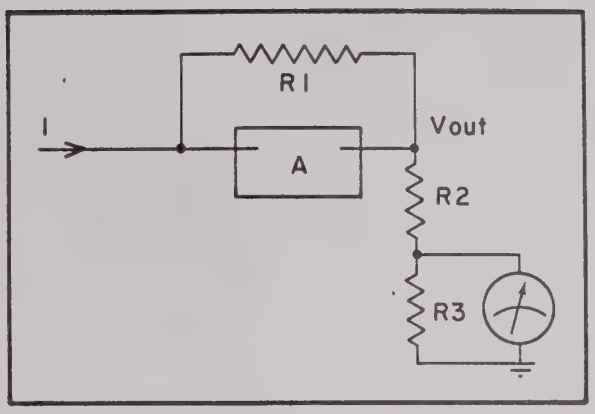


Fig.1b Model 250 Ammeter Configuration.

CIRCUITRY

The Model 250 employs a very low grid current electrometer pentode of V1. Electrode potentials are selected to minimize ionization, and circuit resistors in the input stage are deposited carbon or metal film to minimize noise and temperature drift. The screen potential of V1 is controlled by R12, which is the front panel ZERO control for the amplifier.

The output of V1 is amplified by Q5, a very low leakage NPN transistor. Subsequent amplification by Q6, Q7, and the emitter followers Q8 and Q9 give an overall gain of approximately 1000. The bandpass is reduced by C5 and R21 to prevent oscillation.

The power supply is series regulated by Q1 and Q4, which are referenced to CR5 and controlled by amplifiers Q2 and Q3. CR5 is a temperature compensated zener diode.

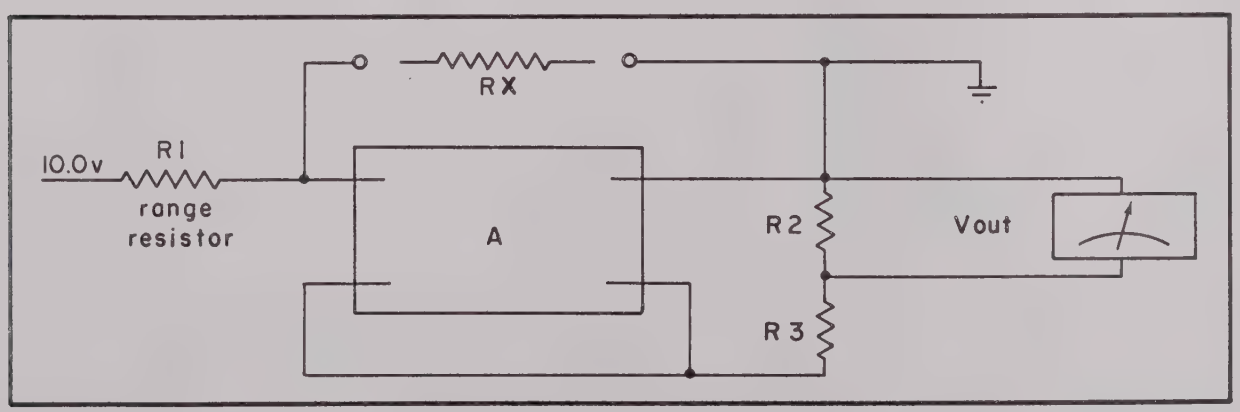


Figure 1c — Model 250 Resistance Configuration.

PARTS LIST

IMPORTANT

ORDERING INFORMATION

Please include the following information when ordering a replacement part.

1. Model and serial number of the instrument for which the replacement part is intended.
2. Circuit reference of the replacement part.
3. E-H stock number.

Replacement parts may be ordered through your E-H representative or from the factory.

CUSTOMER SERVICE DEPARTMENT
E-H RESEARCH LABORATORIES, INC.
1 6 3 ADELINE STREET
OAKLAND 20, CALIFORNIA.
Phone: TE 4-3030
Area Code 415

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
CAPACITORS		
C1	1500 uf, 25v, fixed, electrolytic	316-012
C2	Same as C1.	
C3	25 mf, 25v, fixed, electrolytic	316-028
C4	Same as C3.	
C5	.1 mf, 20%, 75v, fixed, ceramic	311-014
C101	.01 mf, ±10%, 600v, fixed, ceramic	311-012
C102	.001 mf, 10%, 1 KV, fixed, ceramic	311-010
C103-104	Same as C102.	
C105	3.3 pf, 20%, 1 KV, fixed, ceramic	311-002
DIODES		
CR1-4	Type 1N2071, Texas Instruments	376-034
CR5	Type 1N2620A, zener, Motorola	376-038
TRANSFORMER		
T1	Power Transformer	653-014B

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
TRANSISTORS		
Q1	Type 2N250, Texas Instruments	663-026
Q2	Type 2N1305, Texas Instruments	663-017
Q3	Type 2N1304, Texas Instruments	663-013
Q4	Same as Q1.	
Q5	Type 2N929, Texas Instruments	663-031
Q6	Type 2N1309, Texas Instruments	663-021
Q7	Type 2N1308, Texas Instruments	663-020
Q8	Type 2N1302, Texas Instruments	663-016
Q9	Type 2N1303, Texas Instruments	663-011
VACUUM TUBES		
V1	Type CK 5880, Raytheon	670-015

NOTE: Replacement diodes, transistors, and tubes must be from the manufacturer indicated to insure proper operation.

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
RESISTORS		
NOTE:	All resistors shown on the schematic which are not listed below are 1/2 watt, ±5%, fixed, carbon composition.	
R3	1 K, 1%, 1/2 w, fixed, deposited carbon	606-012
R4	Same as R3.	
R5	499 ohms, 1%, 1/2 w, fixed, deposited carbon	606-015
R9	Same as R3.	
R10	5 K, 2 w, variable, composition	545-005
R11	100 K, 2 w, variable, composition	545-009
R12	1 K, 2 w, variable, ten turn, wirewound	540-004
R14	13.7 K, 1%, 1/2 w, fixed, deposited carbon	601-007
R15	1.5 K, 5%, 3 w, wirewound	610-008
R16	511 K, 1%, 1 w, metal film	615-001
R17	225 ohms, 5%, 3 w, wirewound	610-006
R102	3×10^{10} ohms, 10%, 1/2 w, fixed, film	615-012
R103	1 K, 1/2%, 1/2 w, fixed, deposited carbon	606-012
R104	1.01 ohms, 1/2%, 2 w, fixed, wirewound	610-053
R105	10 K, 1/2%, 1/2 w, fixed, deposited carbon	607-013
R106	10.1 ohms, 1/2%, 2 w, fixed, wirewound	610-049
R107	Same as R105.	
R108	10^5 ohms, 1/2%, 1/2 w, fixed, deposited carbon	606-011
R109	Same as R103.	
R110	Same as R105.	
R111	Same as R108.	
R112	10^6 ohms, 1/2%, 1/2 w, fixed, deposited carbon	606-014
R114	10^7 ohms, 1/2%, 1/2 w, fixed, deposited carbon	606-017
R115	10^8 ohms, 10%, 1/2 w, fixed, deposited film	615-003
R116	10^9 ohms, 10%, 1/2 w, fixed, deposited film	615-004
R117	10^{10} ohms, 10%, 1/2 w, fixed, deposited film	615-010
R118	10^{11} ohms, 10%, 1/2 w, fixed, deposited film	615-011
R119	10^{12} ohms, 10%, 1/2 w, fixed, deposited film	615-007
R126	Same as R3.	
R127	Same as R116.	
R128	Same as R115.	
R129	Same as R114.	
R130	Same as R112.	
R131	Same as R108.	
R133	Same as R105.	
R134	100 K, 2 w, variable, composition	550-006
R135-137	Same as R134.	
R138	Same as R5.	
R139-140	Same as R134.	
R142	190.6 ohms, 0.25%, 1/2 w, fixed, wirewound	610-054
R144	5 K, 2 w, variable, composition	545-005
R146	2 K, 2 w, variable, composition	545-010
R148	500 ohms, 2 w, variable, composition	545-002
R149	17.4 K, 1/2%, 1/2 w, fixed, deposited carbon	606-007
R150	5230 ohms, 1/2%, 1/2 w, fixed, deposited carbon	606-006
R151	1740 ohms, 1/2%, 1/2 w, fixed, deposited carbon	606-005
R152	523 ohms, 1/2%, 1/2 w, fixed, deposited carbon	606-003
R153	174 ohms, 1/2%, 1/2 w, fixed, deposited carbon	606-002
R154	52.3 ohms, 1/2%, 1/2 w, fixed, deposited carbon	606-001
R155	17.4 ohms, 1/2%, 1/2 w, fixed, deposited carbon	610-052
R156	4.98 ohms, 1%, 1 w, fixed, wirewound	610-051
R157	1.58 ohms, 1%, 1 w, fixed, wirewound	610-050
R158	3480 ohms, 1/2%, 1/2 w, fixed, deposited carbon	606-024
R159	1130 ohms, 1/2%, 1/2 w, fixed, deposited carbon	606-023
R161	150 ohms, 1%, 1/2 w, fixed, deposited carbon	601-013
R162	2 K, 1/2%, 1/2 w, fixed, deposited carbon	606-008
R163	845 ohms, 1%, 1/2 w, fixed, deposited carbon	601-008
R164	10 K, 2 w, variable, composition	545-006
R165-168	Same as R164.	
MISCELLANEOUS		
	Pilot Light Assembly	510-004
	AC Switch, Smith 512	630-002
	Fuse Holder	396-001
	Power Cord, Belden 17460-S	786-001

E-H RESEARCH LABORATORIES, INC.
163 Adeline Street
Oakland, California 94607

ELECTROMETER RECALIBRATION PROCEDURE

E-H Models 230/240/250

1.) Measure filament voltage: the reading should be 1.0 ± 0.05 volts. Change the selected resistor on the rear of the amplifier board if the reading is out of tolerance.

2.) Allow the instrument to heat run for 72 hours.

3.) Check the -15 volt bus: the reading should be -15 ± 0.1 volts. If the reading is not within tolerance, it will be necessary to recalibrate the electrometer. It is not recommended that the user attempt the recalibration procedure since special test equipment is required.

4.) If the reading obtained in Step 3 is within the tolerance indicated, check and adjust the LINE STABILITY control by applying a stable D.C. voltage which will give approximately full scale deflection on either the 1 mv or 3 mv range. Polarity must be reversible without affecting the magnitude of the applied voltage. The LINE STABILITY control should be adjusted so that the applied D.C. voltage will give equal readings on both polarities. It is extremely important that the ZERO control be very accurately set to ensure that differences in polarities are not due to a zero offset. If it is necessary to reset the LINE STABILITY control, it will also be necessary to reset the (coarse) INTERNAL ZERO ADJUST to maintain the zero setting at about the mid point of the ZERO control. When the instrument reads the same on both polarities, the line stability will also be at optimum setting.

11/23/64

REVISIONS						
ISSUE	REVISION	DATE	DRAWN	CHK'D	APP'D	E.O.
A	ORIGINAL RELEASE	11-5-62	G.B.			
B	VALUE CHANGES	8-7-63	G.B.	JC		

PROPRIETARY INFORMATION
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D-10710 (B)

TITLE:

D-10710 B

SHEET NO. ___ OF ___

C105 3.3 pf
R113 10M 5%

A AMPLIFIER C
B

R161 150Ω 1%
REAR PANEL OUTPUT
R162 2K ½%
M1
S4

S1 RANGE
300
100
30
10
3
1
.3
.1
.03
.01
.003
.001

R102 3×10^{10} 10%
R103 10^3 ½%
R104 1.01Ω ½% 2W
R105 10^4 ½%
R106 10.1Ω ½% 2W
R107 10^4 ½%
R108 10^3 ½%
C101 .01
R109 10^3 ½%
C102 .001
R110 10^4 ½%
C103 .001
R111 10^5 ½%
C104 .001
R112 10^6 ½%

R114 10^7 1%
R115 10^8 10%
R116 10^9 10%
R117 10^{10} 10%
R118 10^{11} 10%
R119 10^{12} 10%

R120 5.1K 5%
R121 100K 5%
R122 100K 5%
R123 100K 5%
R124 100K 5%
R125 100K 5%
R126 1K 1%
R127 10^9 10%
R129 10^7 ½%
R130 10^6 ½%
R131 10^5 ½%
R132 270K 5%
R133 10^4 ½%
R134 100K
R135 100K
R136 100K
R137 100K
R138 499Ω ½%
R139 400K
R140 100K

R142 190.6Ω ¼%
R143 15K 5%
R144 5K
R145 4.3K 5%
R146 2K
R147 1.5K 5%
R148 500Ω
R149 17.4K ½%
R150 5230Ω ½%
R151 1740Ω ½%
R152 523Ω ½%
R153 174Ω ½%
R154 52.3Ω ½%
R155 17.25Ω ½%
R156 5.05Ω ½%
R157 1.58Ω ½%

R158 3.45K ½%
R159 1.13K ½%
R160 2.0K 5%

R163 9.45Ω 1%
GN. R164 10K 10-30 nA
YE. R165 10K 1-3 nA
LB. R166 10K .1-.3 nA
RED R167 10K .01-.03 nA
BN. R163 10K .001-.003 nA

P101 1M 5%

S1-A S1-B S1-C S1-D S1-E S1-F S1-G S1-H S1-I S1-J S1-K S1-L S1-M

INPUT

FUNCTION S2: ☐ VOLTS ☐ MILLIAMPS ☐ NANOAMPS ☐ MEGOHMS ☐ TERAOHMS

IMPEDANCE S3: ◇ SHORT ◇ 10^9 ◇ 8

METER S4: OUT + −

FRONT PANEL OUTPUT

−15V FROM POWER SUPPLY

MATERIAL LIST

QTY PER	ITEM NO.	PART NO.	DESCRIPTION	SCHEMATIC OR SPEC. REQ.

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCE FRACT: ±
DECIMALS: ±
ANGLES: ±
HOLE DIAMETERS: ±
MACHINED SURFACES: √
BREAK & DEBUR SHARP EDGES
DO NOT SCALE DRAWING

E-H RESEARCH LABORATORIES, INC.
OAKLAND, CALIFORNIA

TITLE: MODEL 250 ELECTROMETER MULTIMETER-SCHEMATIC

	INITIALS	DATE	D.W.G. NO.	ISSUE
DRAWN	G.B.	5-27-63	D-10710	B
CHK'D				
APP'D			SHEET NO. ___ OF ___	SHEET #

ISSUED SEP 2 1966

REVISIONS						
ISSUE	REVISION	DATE	DRAWN	CHK'D	APPV'D	E. O.
A	ORIGINAL RELEASE	10-15-62	G.B.			
	VALUE & PARTS	11-7-63	RFS			
B	ADD R34, C5 WAS .1	11/16/64	REH			64-23
C	ADDED R35	8-1-66	BB.	LSB		C65-49

PROPRIETARY INFORMATION
E-H RESEARCH LABORATORIES, INC.
NO INFORMATION GIVEN HEREIN MAY BE DISSEMINATED TO ANY PERSON OR COMPANY WITHOUT THE EXPRESS PERMISSION OF E-H RESEARCH LABORATORIES, INC.

D-10711 C

TITLE: ?

D-10711 C

SHEET NO. ___ OF ___

R14 13.7K 1%
R15 1.5K 3W W.W.
R16 511K 1%
RED
R12 1K
OR.
ZERO
FROM SWITCH A
BRN.
R11 10K
INTERNAL ZERO ADJ.
V1 CK5889
R33 1K
R17 225Ω 3W W.W.
Q5 2N929
R18 330K
Q6 2N1309
R19 200Ω
R20 2K
R21 10K
C5 .47
R24 5.6K
R26 1K
Q8 2N1302
R25 1K
B R34 20K
Q9 2N1303
Q7 2N1308
R23 430Ω
R27 1K
R28 3K
C4 25μF 25V
R29 10Ω
C3 25μF 25V
R22 10Ω
R30 10K 1%
BLK.
*R32 10K
RED/WHT. C AMPLIFIER OUTPUT TO SWITCH
AMPLIFIER PRINTED CIRCUIT BOARD

115 V A.C. 50/60CY.
F1 3/8A
S1
OFF
ON
T1
R1 100K
POWER
DS1
BLK.
BLK. YEL.
BLK. GRN.
BLK. RED
28 V
28 V
YEL.
YEL.
RED
YEL.
FROM SWITCH B
BLK./WHT.
GRN.
LINE STAB.
R31 50K
BRN./WHT.
VIOLET
GRN./WHT.
OR./WHT.
BLK./WHT.
CR1 IN2071
CR2 IN2071
CR3 IN2071
CR4 IN2071
Q1 2N250
R2 4.7K
Q2 2N1305
R3 1K 1%
C1 1500μF 25V
C2 1500μF 25V
Vo
R4 1K 1%
CR5 IN2620
Q3 2N1304
R5 499Ω 1/2%
R7 510Ω
R9 1K 1%
Q4 2N250
R6 1K
R8 39Ω
R35 51K
BLUE
OR. WHT.
+15V
-15V
+10V
-15V ADJUST
R10 5K
POWER SUPPLY PRINTED CIRCUIT BOARD

PRIMARY CONNECTION OF TRANSFORMER FOR 230V A.C.
F1 = 1/4 A
T1
BLK.
BLK. YEL.
BLK. GRN.
BLK. RED

NOTES:
UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTANCES GIVEN IN OHMS.
2. ALL RESISTORS ARE 1/2 W, 5%
3. ALL CAPACITANCES GIVEN IN MICRO-FARADS
4. VOLTAGES MEASURED WITH RESPECT TO Vo
* VALUE SELECTED AT FACTORY OR PART MAY BE OMITED.

MATERIAL LIST

QTY -01	ITEM NO.	PART NO.	DESCRIPTION	SCHEMATIC OR SPEC. REF.

UNLESS OTHERWISE SPECIFIED
SCALE:
DIMENSIONS ARE IN INCHES
TOLERANCE FRACT.: ±
DECIMALS: ±
ANGLES: ±
HOLE DIAMETERS: ±
MACHINED SURFACES:
BREAK & DEBURR SHARP EDGES
DO NOT SCALE DRAWING

ISSUED SEP 2 1966

E-H RESEARCH LABORATORIES, INC.
OAKLAND, CALIFORNIA

TITLE: 230, 240, 250
ELECTROMETER AMPLIFIER & POWER SUPPLY

	INITIALS	DATE	ID. NO.	DWG. NO.	ISSUE
DRAWN	G.B.	4-27-62		D-10711	C
CHK'D					
APP'D				SHEET NO. ___ OF ___ SHEETS	

MP MASTER
MA27860